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Water Scarcity and Development
in the Tigris-Euphrates River Basin

by

Christopher Theophil Zabriskie, B.A.

Report

Presented to the Faculty of the Graduate School
of the University of Texas at Austin
in Partial Fulfillment
of the Requirements
for the Degree of

Master of Arts

The University of Texas at Austin

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Water Scarcity and Development
in the Tigris-Euphrates River Basin

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Preface

"Although actual physical conditions vary from nation to nation, attitudes about water do not: in every country, access to clean water is considered an undeniable right, and tampering with water supplies is considered an unspeakable crime."¹

-Joyce Starr

Joyce Starr's statement is perhaps nowhere more true than in the Middle East, where the population depends heavily on a few major rivers for much of its water. Several factors intensify demands on scarce resources. Among those factors are irrigation, rapid population growth, and the desire for economic expansion.

Not surprisingly in view of the region's general aridity, states throughout the region have sought, and continue to seek innovative measures to meet the accelerating demand for water. For instance, Saudi Arabia and other Gulf states revitalize their deserts with fresh water processed from sea water. In an equally creative endeavor, Libya's Mohamar Khadaffi continues to work on a man-made river fed from a groundwater aquifer (the Great Manmade River). Egypt has also invested billions in water development, constructing its Aswan High Dam on the Nile. Further, Jordan and Israel are considering canal projects to

¹Joyce R. Starr and D. C. Stoll, U.S. Foreign Policy on Water Resources in the Middle East, (Washington: Center for Strategic and International Studies, 1987), p. 1.

link the Dead Sea to the Red Sea or Mediterranean. Finally, Turkey, Iraq, and Syria have undertaken projects to harness the waters of the Tigris and Euphrates Rivers. It is those projects that I will focus on in this report.

This report will examine aspects of water scarcity and development, and discuss solutions available to avoid conflict over water in the Tigris-Euphrates River Basin.

Chapter one introduces the reader to the geography of the region and some of the development projects planned along those rivers. This introduction examines the history of agreements and disputes over the waters of the Tigris and Euphrates. The second chapter considers the availability of water resources in the Tigris-Euphrates River Basin, both before and after the completion of planned development projects. Chapter three then addresses some aspects of demand for water and explores how some ways demand may be reduced. The fourth chapter looks at the possible efficacy of international law in solving riparian disputes over water rights in the Tigris-Euphrates River Basin. And finally, the fifth chapter explores the viability of a series of available options to the states dependent on the Tigris-Euphrates River Basin for water.

ABSTRACT

Solutions to Development Related Water Scarcity
in the Tigris-Euphrates River Basin

by

Christopher Theophil Zabriskie, M.A.

The University of Texas at Austin, 1995

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This report examines the history of agreements and disputes in the Tigris-Euphrates River Basin, and discusses possible options for finding a solution to projected scarcity and thereby avoid what some predict may be the next great war in the Middle East. This report accomplishes this analysis by evaluating available data, current development plans, and proposed solutions to the problem.

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CHAPTER 1

Overview and Background of Tigris-Euphrates Basin and Associated Development Projects

1.1 Introduction

In order to better take advantage of its water resources, each country in the Tigris-Euphrates River Basin has undertaken several water development projects. The Tigris and Euphrates Rivers serve as important sources of water in this predominantly arid region. The rivers in that basin account for 28.5% of Turkey's, 88% of Syria's and 100% of Iraq's total surface flow.

The largest and most controversial development project in the Tigris-Euphrates Basin is Turkey's Southeast Anatolian Project (GAP).² Turkey's development of the Basin began in the 1970's, and by the time it reaches completion in 2040³, it will have cost well over \$30 billion. In all, the GAP consists of 22 dams,⁴ 19 hydro-electric plants, and many irrigation projects. Syria and Iraq also have

²In Turkish the name for this project is the 'Güneydoğu Anadolu Projesi.'

³The GAP was initially planned to be completed by 2005, but Kolars and Mitchell estimate that it will not be completed until as late as 2040.

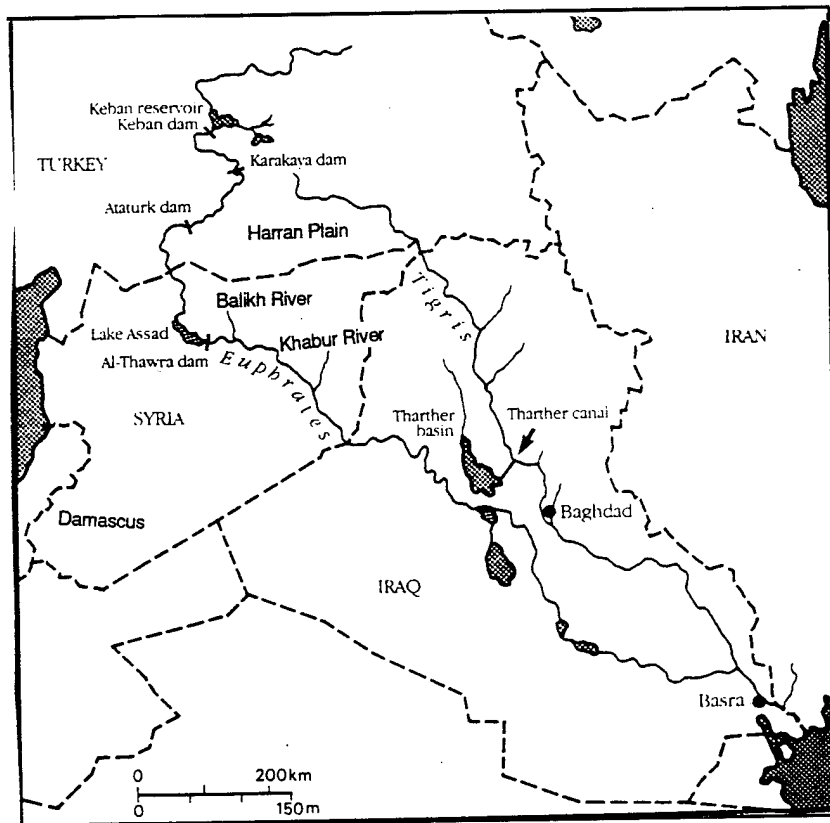
⁴Although not officially part of the GAP the Keban Dam on the Euphrates was undertaken with similar goals to those of the GAP. Many sources include this dam as part of the GAP, and for simplicity's sake I have done so as well.

development plans for the Tigris-Euphrates Basin. The potential consequences of increased Turkish water usage, and therefore reduced flow and quality of water downstream, may preclude Syria and Iraq's development plans and even prevent them from fulfilling their current needs. As discussed in detail later in this chapter, the effects of the GAP on Iraq and Syria are potentially so severe that they have drawn the two historic foes together in opposition to it. Further the projected on the resource base has led some experts to predict that the next great war in the Middle East will be over the waters of the Tigris-Euphrates River Basin.^{5,6}

This chapter introduces the reader to the geography of the Tigris-Euphrates Basin and the long history of development projects along those rivers. I will address the patterns of development occurring in Turkey, Iraq and Syria, and examine how they have led to various agreements and disputes in the past three decades.

⁵Thomas Naff and Ruth C. Matson, Water in the Middle East: Conflict or Cooperation?, (Boulder, CO: Westview Press, 1984).

⁶John Bulloch and Adel Darwish, Water Wars: Coming Conflict in the Middle East, (London: IC Publications, 1994).



Map 1.1 Tigris-Euphrates River Basin. Angus Hindley, "Battle Lines Drawn for Euphrates" *Middle East Economic Development*, 13 October 1989, p. 5.

1.2 Tigris-Euphrates River Basin

The Euphrates river, the longest in Asia west of the Indus, rises in eastern Turkey and flows 2,700 kilometers through Syria and Iraq before emptying into the Persian Gulf. The Euphrates average annual flow at the Syrian-Iraqi border is 32.7 billion cubic meters (BCM)/year.⁷ The river's greatest flow occurs in the months of April and May; this spring maxima is

⁷US Army Corps of Engineers, Water in the Sand: A Survey of Middle East Water Issues, June 1991.

primarily due to the melting snows in Turkey. The average water volume during the maximum flow in May is 28 times greater than the river's flow during the minimum flow in September.⁸

The Tigris also originates in the Anatolian highlands, to the east of the Euphrates' source. Although shorter than the Euphrates by nearly 1,000 km, it carries a larger flow, which as measured at Baghdad equals 49.2 BCM/year.⁹ The Tigris receives large quantities of water from tributaries originating in the Zagros mountains and its annual average flow at the Turkish-Iraqi border is only 18.5 BCM.¹⁰ Because of the great degree of seasonal variation, with maximum flow 80 times greater on average than minimum flow, the Tigris has a reputation for devastating floods.

The combined natural flow of the Tigris and Euphrates varies between 68-84.4 BCM per year.¹¹ The

⁸This compares to a factor of 2 for the St. Lawrence river in North America and only 8 for the Nile. John F. Kolars and William A. Mitchell, The Euphrates River and the Southeast Anatolia Development Project (Carbondale, IL: Southern Illinois University Press, 1991), p. 78.

⁹US Army Corps of Engineers.

¹⁰Ali Ihsan Bağış, "Water in the Region: Potential and Prospects - An Overview," in Ali Ihsan Bağış ed., Water as an Element of Cooperation and Development in the Middle East (Istanbul: Ayna Publications, 1994), p. 18.

¹¹Nurit Kliot, Water Resources and Conflict in the Middle East (New York: Routledge, 1994), p. 110. Kliot cites various sources including Alii 1955: 30; Ubell 1971: 3; Beaumont, Blake and Wagstaff 1988: 364; Shahin

rivers eventually converge in southern Iraq, to form the *Shatt al-Arab*, 179 km north of the Persian Gulf. Today almost 28 million people living in the Tigris-Euphrates Basin depend on those waters for agriculture and domestic consumption as well as industry. This amounts to 8.5% of Turkey's 1990 population, 50% of Syria's and 100% of Iraq's.

1.3 Turkey

Of all the countries in the Middle East, Turkey has the most abundant water supply. Turkey receives 186 BCM/year from internal renewable water resources (predominantly from precipitation), and an additional 7 BCM/year from rivers originating outside of the country. For each Turk, there is 3,310m³ of fresh water. Despite having more water than any other country in the Middle East, Turkey's water resources per capita are still below the world average, and far below the 10,000m³ per capita which defines a state as being "water rich."¹²

Turkey wishes not only to be self-sufficient in agriculture, but to increase its export of food. In order to take its place as a modern state as part of Europe, Turkey realizes it also needs to develop its industrial, manufacturing, and service sectors as a way

1989; US Army Corps of Engineers 1991.

¹²World Resources Institute, World Resources 1994-95: A Guide to the Global Environment (New York: Oxford University Press, 1994), p. 346.

of achieving sustained improvements in standards of living. Consequently, water development is seen as providing the key to economic growth and regional development. Turkey intends to increase production of industrial and cash crops, such as cotton, tobacco, and sugar beets, by introducing large scale irrigation to the area. Also, with vast amounts of hydroelectric production from dams on the Tigris and Euphrates, the country plans to have the energy required for extensive industrial expansion.

1.3.1 The GAP

The GAP is a comprehensive development program designed to improve Turkey's industrial capability and to increase the standard of living in the rural southeastern provinces. While centered around the water resources of the Tigris and Euphrates rivers, the GAP goes far beyond water management. As part of the GAP, roads, factories, and airports are being developed in order to take advantage of the benefits provided by the water development.

The GAP includes plans to construct 10 dams on the Euphrates and 12 on the Tigris. The centerpiece of the GAP is the \$4 billion Atatürk Dam. Now completed, it is the largest dam in Turkey, and fourth largest in the world. Water collected behind the Atatürk Dam is pumped through the two 26.5 km long Şanlı Urfa Tunnels, the world's largest water tunnels, to the Harran Plain (see map 1.1). Each tunnel is 7.62 m in diameter and

has a capacity to carry $328 \text{ m}^3/\text{s}$.¹³ This project alone will irrigate 792,700 hectares (ha) of fertile land.

As mentioned earlier, Turkey plans to generate large amounts of hydro-electric power by harnessing the waters of the Tigris and Euphrates. Through this, the country intends to increase its power production by 8,753 megawatts (MW), nearly a 70% increase from its existing electrical production.¹⁴ With this action, Turkey will be transformed from a net energy consumer to an energy exporter. Plans are already well-advanced for a Middle Eastern power grid which would include both Syria and Iraq.¹⁵ Some projects are already in operation, including several plants producing hydro-electric power and irrigating the Harran Plain.¹⁶ When completed, the GAP will irrigate over 1,700,000 ha in the previously neglected southeastern regions of Turkey.

Early estimates predict that the GAP will deplete between 17.5% and 34% of the Euphrates' water in Turkey.¹⁷ However, Starr estimates that those

¹³"Turkey, Positioned for Growth," *Institutional Investor*, February 1994.

¹⁴Kliot, p. 127. Specifically 6,538 MW on Euphrates Dams and 2,215 MW on Tigris Dams.

¹⁵John Murray Brown, "Iraq Muddies Waters Over Turkey-Syria Dam Deal: Threats Over Euphrates Project," *Financial Times*, February 10, 1993.

¹⁶"Turkey Unleashes Water to Ancient Plain," Reuters, 16 November 1994.

¹⁷Naff and Matson, p. 91.

withdrawals may be as high as 30-40%,¹⁸ while Nurit Kliot adds 10% to this figure for water lost due to evaporation.¹⁹

The development of the GAP hitherto has centered around the Euphrates river, while progress along the Tigris' is only in the beginning stages. The 12 dams planned on the Tigris will be mainly geared toward the production of hydroelectric power because the Tigris' steep grade and nearby rough terrain make it less suitable for agriculture. So far, four dams have been completed on the Euphrates, while the first on the Tigris was due to be completed in late 1994.

Critics of the GAP blame the project for runaway inflation due to diversion of scarce investment capital, but the benefits of the GAP will not be evident for another 10 to 20 years.²⁰

1.4 Syria

Syria receives only 7.6 BCM/year from internal sources, while it receives 24.9 BCM/year from exotic rivers, primarily the Euphrates. Syria has access to 2,663m³ of water per capita, most of which passes through its borders from Turkey to Iraq.

The country's water development goals include increasing agricultural production, generating

¹⁸Joyce S. Starr, Covenant over Middle Eastern Waters: Key to World Survival, (New York: Henry Holt and Company, to be published June 1995), p. 149.

¹⁹Kliot, p. 131.

²⁰Starr, Covenant, p. 127.

hydroelectric power, and ensuring the availability of drinking water. Expanded agriculture in the Euphrates Basin will help Syria reduce its dependence on imported food as well as "promote agro-related manufacturing industries such as cotton textiles, edible oils, vegetable and fruit processing, and milk processing."²¹

The centerpiece of Syria's development project is the Tabqa Dam on the Euphrates. Opened in 1973, this dam was supposed to provide irrigation for an area of 600,000 to 650,000 ha. Unfortunately for Syria, the results, as of the mid-1980's, have been disappointing.²² Much of the soil in Syria is of poorer quality than anticipated, and the gypsiferous content has led to salinity problems.

Syria also plans to construct the Tishreen Dam. Upstream from Tabqa, this dam is in the preliminary planning stages, but Syria hopes it will be a source of additional irrigation water and hydroelectric power. In addition to those projects, the country plans to develop irrigation for 138,000 ha on the Khabur river.

Hydroelectric production at the Tabqa facility has been very low, and dependent on water released by Turkey. In fact, since the completion of the Atatürk Dam, Tabqa's hydroelectric production has frequently been under 10% of capacity.²³

²¹Mikhail Wakil, "Sharing the Euphrates: Syria" *Research and Exploration-Water Issue*, 1993.

²²Naff and Matson, p. 90.

²³U.S. Army Corps of Engineers.

1.5 Iraq

Iraq is the most arid of the three states. For that reason, the country contributes very little water to the Euphrates and Tigris. The topography of Iraq is generally flat which leads to slow moving wide swaths of river, susceptible to high evaporation loss.

Iraq's development goals include halting loss of agricultural land to salinity, a problem which causes the loss of thousands of hectares each year because of high temperatures and poor drainage.²⁴ Unfortunately, increased Turkish and Syrian withdrawals from the Euphrates will likely aggravate Iraq's problems. Iraq will also need to meet the domestic consumption needs of a rapidly growing population.

Iraq is the only state that has, so far, taken advantage of the waters of the Tigris, and has several projects in the planning stages or under construction on that river. Those projects are intended to meet a variety of needs including irrigation, hydropower production, flood control, and drinking water storage.²⁵ Fortunately, for Iraq, Turkey's plan to develop the Tigris waters centers around hydro-electric power production, and only limited irrigation. For that reason, the Tigris will continue to be good source of fresh water for Iraq, at least for the next few decades until Turkey completes its GAP projects. Iraq has the ability to transfer water from the Tigris to

²⁴Kliot, 159.

²⁵US Army Corps of Engineers.

the Euphrates through its Tharthar Canal. Water from the Tigris may therefore be used to compensate for upstream withdrawals from the Euphrates by Turkey and Syria.

While historically the leader in development of the Tigris-Euphrates Basin, over the last 15 years Iraq has suffered through wars, resulting in severe setbacks to the economy. For instance, 80% of planned projects on the Euphrates River have been halted in the aftermath of the Gulf War.²⁶ Iraq's most ambitious projects is the Main Outfall Drain (MOD), which was due to be completed in 1992.²⁷ The purpose of the MOD is to drain saline runoff from 1.5 million ha to the *Shatt al-Arab*, and decrease the harmful effects. Because of the international boycott as a result of the Gulf War, and a foreign debt of \$80 billion, Iraq's immediate priority is greater food production.²⁸

1.6 Current Agreements and Disputes

Currently, agreements governing water use exist only for the Euphrates River. The Tigris River is far less exploited by riparians, and therefore major conflicts have yet to arise.

The history of agreements along the Euphrates

²⁶Adai Hardan, "Sharing the Euphrates: Iraq" *Research and Exploration*, Water Issue, 1993, p. 75.

²⁷There is no available information yet on the state of the project in 1992 in the aftermath of the Gulf War. Kliot, p. 146.

²⁸Kliot, p. 159-60.

began in 1964, when Turkey pledged to supply a minimum of 350 m³/s to Syria as part of an agreement to pave the way for USAID funding for the Keban Dam (USAID had refused to grant funding until some settlement was reached.).²⁹

In 1975, the filling of the Tabqa Dam almost caused a war between Syria and Iraq over Euphrates' water. The dispute was resolved when Saudi Arabia mediated an agreement in which Syria agreed to release a portion of 'its share' of the Euphrates as a gesture of good will to the people of Iraq. Under that settlement Syria did not relinquish its claim to the water, but there was a reduction in tension.

One year later, Turkey unilaterally announced an increase in the minimum flow released to downstream riparians from 350m³/s to 450m³/s, and thereby paved the way to receive World Bank funding for the Karakaya Dam on the Euphrates.

In 1980, a Tri-National Joint Technical Committee was established for information exchange and to seek ways for more "rational and optimal" usage of the Tigris and Euphrates. But the success of that committee has been limited to information exchange, and that 'sharing' has failed to take place since June 1993 when Syria refused to attend until the political

²⁹Gün Kut, "Burning Waters: The Hydropolitics of the Euphrates and Tigris" *New Perspectives on Turkey*, Fall 1993, p. 4.

deadlock could be overcome.³⁰

In the early 1980's, while Turkey was completing its Karakaya Dam and beginning work on the Atatürk Dam, Syria was also involved in studying the feasibility of constructing the Tishreen Dam upstream from Tabqa. For this reason tensions over water intensified. In fact, in 1986 there were reports that Turkey had uncovered a Syrian plot to blow up the Atatürk Dam.³¹ And in 1987, Turkey allegedly hinted at reducing the Euphrates flow to Syria in response to Syrian support for the Kurdish Worker's Party (PKK).³² In June of that year, Turkey and Syria temporarily settled their dispute by agreeing on a "Protocol on Economic on Economic Cooperation," which covered a wide range of issues including a Turkish agreement to release a yearly average of 500m³/s, and Syrian agreement to withdraw its support from the PKK. Turkey however, emphasized that this was to be a temporary agreement, and that Turkey retained the 'rights' to all of the Euphrates' water which originated within its borders.

On January 13, 1990, to partially fill the Atatürk Dam, Turkey temporarily stopped the flow of the Euphrates River. The country informed Syria and Iraq of its intentions and provided both with appropriate

³⁰ 'Political deadlock' refers to the lack of a permanent settlement on sharing the Euphrates' waters.

³¹ Joyce Starr, "Water Security: The Missing Link in our Mideast Strategy," *Canadian Journal of Development Studies*, Special Issue, 1992, p. 44.

³² Starr, "Water Security," p. 45.

technical information beforehand. Turkey also supplied additional water, in excess of its pledged 500m³/s during the month prior to the stoppage to allow the countries to store water to meet their needs. Nevertheless, the interruption of flow drew strong complaints from Syria and Iraq.³³ Turkey was put on the defensive as it reacted to stories of attempting to use water as a political weapon. Because of international pressures, Turkey resumed the Euphrates' flow one week ahead of schedule. Whether intentional or not, Turkey had sent an unmistakable message to its downstream neighbors; that it, and it alone, could control the waters of the Euphrates.

More recently, Iraq and Syria signed a bilateral agreement to split their portion of the Euphrates' waters 42-58% respectively. Shortly thereafter Syria and Iraq both demanded that Turkey increase the flow of the Euphrates across the Turkish-Syrian border to 700m³/s.

1.7 Conclusion

Since the Tigris and Euphrates are central to economic development goals in Turkey, Syria and Iraq, each country has pursued far-reaching water development programs. Those development programs have already brought riparian states close to conflict; today there exists no permanent agreement on the waters of the Tigris and Euphrates Rivers to prevent future disputes.

³³Kut, p. 2.

CHAPTER 2

Water Supply in the Tigris-Euphrates Basin

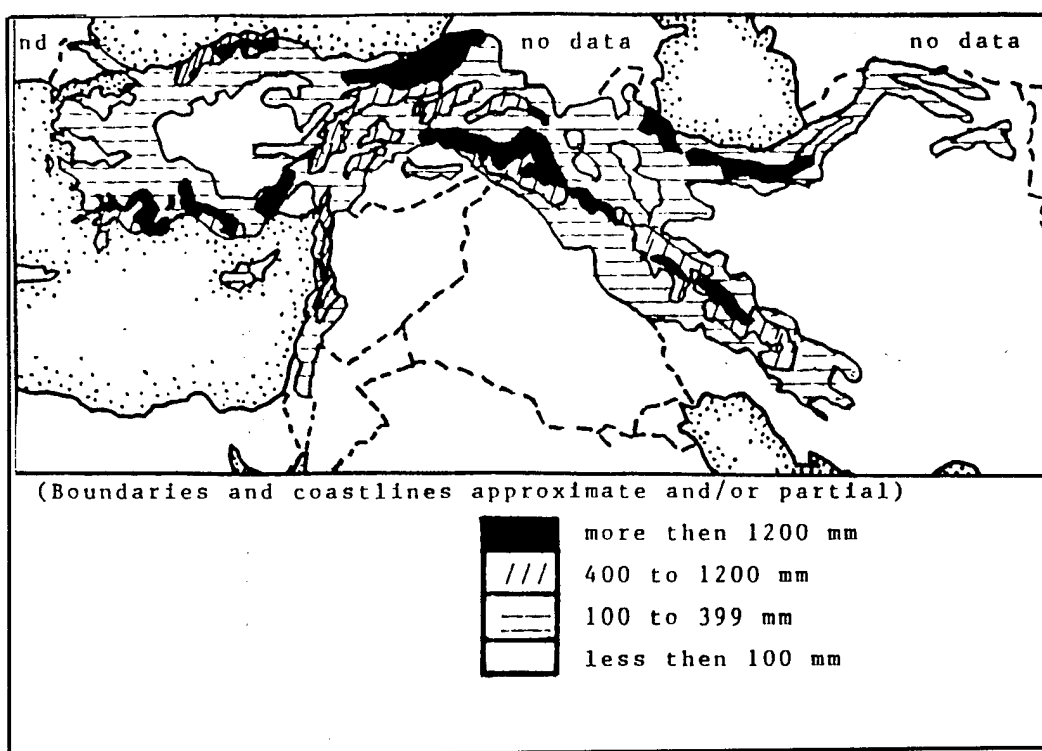
2.1 Introduction

The suggestion that water supply may become insufficient to meet the needs of the states sharing the Tigris-Euphrates Basin seems to have become widely accepted. Desalinization, water transfer, and recycling offer ways of increasing the available water supply, and will be examined in a later chapter. This chapter focuses on the naturally occurring water resources available in the Basin. My objectives are 1) to show how much water is available in the Tigris-Euphrates River Basin, 2) to demonstrate how planned demands will exceed available supply if they are fully implemented, and 3) to explain how the water deficit will be particularly serious in years when there is a lower than normal amount of water in the Basin.

The US Army Corps of Engineers has completed a rather detailed study of this information, and it will serve as my primary reference.³⁴ However, the data provided are best estimates, and mainly from secondary sources. Because Turkey, Syria and Iraq treat their water data as highly sensitive classified information, it is difficult to obtain or rely on official sources.³⁵ Figures given in this section will appear in terms of billion cubic meters (BCM) per year.

³⁴US Army Corps of Engineers.

³⁵Hillel, p. 274.



Map 2.1 Precipitation in Tigris-Euphrates Basin. Naff and Matson, p. 286.

2.2 Water Quantity

The rainfall in the Tigris-Euphrates Basin varies widely from north to south (map 2.1). Most of the rain falls in the highlands of Turkey, while Syria and Iraq receive very little.

According to the US Army Corps of Engineers, the total average annual runoff of the Euphrates, Tigris, and the Tigris' tributaries is 79.9 BCM.³⁶ Of this amount, over 50% occurs during two months of the spring

³⁶US Army Corps of Engineers.

snowmelt. The lowest flows occur during the late summer and early fall. Dam and storage projects are helpful in reducing the seasonal variation in stream flow, and in ensuring a reliable year-round supply of water for irrigation, power generation and industry.

2.2.1 The Euphrates' Supply - Natural Regime

Precipitation in Turkey is responsible for the majority of the Euphrates' flow. While Turkish territory covers only 28% of the Euphrates Basin, it contributes 88-98% of the Euphrates' waters. Syria occupies 17% of the Basin but provides only between 2% and 12% of the Euphrates' flow.³⁷ Much of Syria's contribution comes from the Khabur and Balikh rivers which rise in a series of springs near the Turkish border. Iraq, covering the largest portion of the Euphrates Basin (40%), provides no significant amount of water to the river.³⁸ The rest of the Euphrates basin extends over the Iraqi border into Saudi Arabia, but Saudi Arabia makes neither contribution to, nor use of the river's waters.

The annual average discharge of the Euphrates, as measured at the Keban reservoir in Turkey, is 20 BCM (figure 2.1).³⁹ By the time it reaches the Syrian

³⁷US Army Corps of Engineers. The range in estimated contribution depends on whether or not you consider water which falls in Turkey, percolates into the ground to emerge as spring flow in Syria to be a Turkish or Syrian contribution.

³⁸US Army Corps of Engineers. Some other sources attribute as much as 3% to Iraqi sources.

(in MCM/yr)	Pre-water projects		Projected (Year 2000+)		
	Avg. Annual	Low Flow (30-40yrs record)	Avg. Annual	Available (Shortfall)	Low flow Avail. (Shortfall)
Euphrates: Flows to Keban Reservoir	20,000				
Turkey: Turkish withdrawals (reservoir evaporation & irrigation withdrawals (1,100kHa)): Irrigation return flows directly to Euphrates: Subtotal: net withdrawals in Turkey:			- 24,300 + 2,800 21,500		
Euphrates flows to Syria	28,200	12,600		6,700	<-8,900>
Syria: Tributary inflows: Irrigation return flows from Turkish projects: Syrian withdrawals (reservoir evaporation & irrigation withdrawals (430,000kHa)): Syrian irrigation return flows:			+ 4,500 + 4,600 - 12,600 + 3,700		
Euphrates flows to Iraq	32,700	10,330		6,900	-910
Inflows of Tharthar diversion from Tigris			assume no diversion		?
Iraqi withdrawals (reserv. evap. & irrig. withdrawals (1,550kHa))	-17,000		- 17,600	<-10,700>	
Irrigation return flows (assume discharge to Main Outfall Drain)			+ 4,300		
Tigris:					
Turkey: Runoff in Turkey: Turkish withdrawals (reservoir evaporation & irrigation withdrawals (600kHa)): Irrigation return flows: Subtotal: net Turkish withdrawals:	18,500		18,500 - 9,500 + 2,800 + 6,700		
Tigris flow to Iraq	18,500			11,800	
Inflows - downstream to Mosul	+2,000		+ 2,000	13,800	
Flow at Mosul	20,500	est. 6,900			
Tributary inflow (Greater Zab, Lesser Zab, Adhaim, Diyala)	28,700		+ 28,700	42,500	
Irrigation withdrawals (tributaries & Upper Tigris to Baghdad)	-23,400		- 23,400	19,100	
Diversion to Euphrates via Tharthar Canal			assume no diversion		
Irrigation return flows (tributaries & Upper Tigris to Baghdad)	+6,000		+ 6,000	25,100	
Irrigation withdrawals (downstream from Baghdad)	-8,600		- 8,600	16,500	
Total M&I unreturned (withdrawals minus returns)	-1,200		- 1,900	14,600	
Total reservoir evaporation losses			- 4,900	9,700	
Irrigation return flows discharged to Main Outfall Drain			2,200		
Estimated net flow to Shatt al-Arab				9,700	
Shatt al-Arab flow (total Tigris & Euphrates inflows) & Karun				14,500	0
Total Main Outfall Drain (Tigris & Euphrates)			6,500		
Total return flow (not including Main Outfall Drain)			20,000		

Figure 2.1 Data on Tigris-Euphrates Discharge and Withdrawals, US Army Corps of Engineers.

border, because of various inflows to the Euphrates in Turkey, the annual average discharge amounts to 28.2 BCM.⁴⁰

Syria contributes an estimated 4.5 BCM annually through miscellaneous inflows, including the Khabur and Balikh Rivers. Based on those contributions, in the absence of any upstream diversion, the Euphrates flow entering into Iraq would average 32.7 BCM/year.⁴¹

2.2.2 The Tigris Supply - Natural Regime

The portion of the Tigris Basin lying within Turkey is only 12%. Nevertheless, Turkey supplies 40% of the Tigris' waters. A minute portion (0.2%) of the Tigris catchment lies within Syria, and thus Syria contributes no significant amount of water to the flow of the river. The largest portion of the Tigris Basin lies within Iraq, and it contributes the largest percentage of flow (51%) to the river, most coming from rain which falls on the Iraqi side of the Zagros Mountains. The remainder of the Tigris Basin falls within Iran, which contributes 9% to the river.⁴²

The total water supplied to the Tigris River inside Turkey averages 18.5 BCM/year. Pre-GAP Turkey

³⁹Haditha, 1979; and UNESCO, 1971, as cited in US Army Corps of Engineers.

⁴⁰Kolars & Mitchell, as cited in US Army Corps of Engineers.

⁴¹Kolars & Mitchell, as cited in US Army Corps of Engineers.

⁴²US Army Corps of Engineers.

had no development on the Tigris River, and used only insignificant amounts of that water; therefore near the full amount flowed into Iraq.

Once the Tigris crosses into Iraq it is joined by miscellaneous

inflows of 2
BCM above
Mosul. That
20.5 BCM is
then

increased by
several
larger Tigris

tributaries above the Tharthar Canal including the Greater Zab and Lesser Zab which add 22.5 BCM/year. Below the Tharthar Canal the Tigris is joined by the Adhaim and the Diyala which contribute 6.2 BCM/year to the Tigris. This makes the total natural flow of the Tigris 49.2 BCM/year.

Natural Flow	28.2 BCM
Evaporation Loss	-3.3 BCM
Irrigation Withdrawals	-21.0 BCM
Return Flow in Turkey	+2.8 BCM

Flow to Syria	6.7 BCM

Figure 2.2 Euphrates - Summary of Projected Withdrawals and Inflows in Turkey.

2.3 Projected Withdrawals for 2000 and Beyond

The U.S. Army Corps of Engineers' study includes the most comprehensive analysis of post-development estimated withdrawals (figure 2.1). It draws on a wide range of collected data about the Basin, and bases its projections of withdrawals on 1) full implementation of planned development as well as on 2) widespread use of traditional irrigation methods. Those estimates may be modified if projects are abandoned or if methods of water use change. Also, since little new data about Iraqi development is available, Iraqi uses were

estimated to be similar to uses in the 1970's.⁴³

2.3.1 The Euphrates Supply-Projected Development 2000+

Because of GAP related diversions and losses related to evaporation from storage reservoirs and irrigations systems, there will be an estimated post project net withdrawal of 21.5 BCM/year in Turkey (figure 2.2). This includes a total loss of 3.3 BCM/year due to evaporation and 21 BCM/year from irrigation uses. Out of this 21 BCM, an estimated 35% or 7.4 BCM/year will be returned to the Euphrates, but only a small share (2.8 BCM) will occur in Turkish territory. Therefore theoretically the average flow at the Turkish-Syrian border will be reduced to 6.7 BCM/year. Since Turkey currently promises Syria 500m³/s from the Euphrates, it is difficult to see how Turkey will reconcile its commitments with its needs in the future.

Syria's
estimated
contribution of
2.5 BCM/year to
the flow of the
Euphrates will
increase 4.6
BCM under post
development
scenarios due
to irrigation

Flow at Turkish Border	6.7 BCM
Miscellaneous Inflows	+2.5 BCM
?Balikh and Khabur	+2.0 BCM
Return Flow from	
Turkish Irrigation	+4.6 BCM
Evaporation Loss	-2.0 BCM
Irrigation Withdrawals	-10.6 BCM
Return Flow from	
Syrian Irrigation	+3.7 BCM

Flow to Iraq	6.9 BCM

Figure 2.3 Euphrates - Summary of Projected Withdrawals and Inflows in Syria.

⁴³US Army Corps of Engineers.

runoff from Turkish projects to 7.1 BCM/year (figure 2.3). Syria will lose a total of 2 BCM/year from storage evaporation and 10.6 BCM/year to irrigation projects covering a total of 528,000 ha. Of those irrigation withdrawals 3.7 BCM/year will be returned to the Euphrates in Syria. According to the US Army corps of Engineers study, as well as Nurit Kliot's analysis of that study and other data, there appears to be 2.0 BCM unaccounted for in the projected calculations. If this 2.0 BCM indeed exists, most likely as additional flow in the Khabur and Balikh Rivers, the water flow leaving Syria would be 6.9 BCM.⁴⁴ Whether 4.9 BCM or 6.9 BCM, it is clear that the volume of water in the Euphrates will be drastically reduced if development projects in Turkey and Syria are fully implemented.

Iraq, while losing some of the Euphrates' water (.6 BCM) to evaporation from the Haditha Reservoir, currently uses 17 BCM/year for irrigation. If Turkey and Syria fully implement their plans, a water deficit would exist for Iraq's portion of the Euphrates.⁴⁵ Further, Kolars and Mitchell estimate that even if Turkey achieves only 75% of the potential depletion projected for the GAP, Iraq will suffer shortfalls by the year 2000.⁴⁶ Based on this data it is clear that the goals of the GAP and of Syria's plans to increase

⁴⁴Kliot, p. 141, and US Army Corps of Engineers.

⁴⁵US Army Corps of Engineers.

⁴⁶Kolars and Mitchell, as cited in US Army Corps of Engineers.

water use are incompatible with Iraq's current use of the Euphrates in an average year.

2.3.2 The Tigris Supply - Projected 2000+

New development in the Tigris Basin will occur primarily in Turkish territory. However, water usage in Iraq will also increase due to increased evaporation from new storage reservoirs and from increased domestic consumption. While it is likely that Iraq will try to expand agriculture, there is no evidence that it has formal plans to do so.

According to Turkey's plans, the GAP will reduce the Tigris by 6.7 BCM annually (figure 2.4). Evaporation losses will account for 1.1 BCM/year while irrigation withdrawals for 600,000 ha will amount to 8.4 BCM. Irrigation runoff and drainage will return 2.8 BCM will return to the Tigris, leaving 11.8 BCM to flow to Iraq each year.

In Iraq, evaporation from reservoirs will total 4.9 BCM annually. Net domestic consumption by the year 2000 is expected to rise from 1.2 BCM to 1.9 BCM. That leaves 30.7 BCM to meet the agricultural water needs of Iraq, which Kliot estimates to be

Natural Flow	18.5 BCM
Evaporation Loss	-1.1 BCM
Irrigation Withdrawals	-8.4 BCM
Return Flow from Syrian Irrigation	+2.8 BCM

Flow to Iraq	11.8 BCM

Figure 2.4 Tigris - Summary of Projected Withdrawals and Inflows in Turkey.

over 40 BCM/year.⁴⁷

Again, it is evident that if those estimates turn out to be even close to accurate, Turkey's development would have a severe impact on Iraq's use of the Tigris. Not only would Iraq need to curtail its practice of irrigated agriculture, but it would also not be able to count on the Tigris' water as a supplement to the Euphrates.

2.4 Low Flows

As mentioned earlier there are large variations in water volume from month to month and year to year. Sometimes, the flow of the Tigris and Euphrates rivers are below average for several years in succession. Based on the previously stated projections, and a low flow of 12.6 BCM, which could be expected to occur every 30 to 40 years on the Euphrates, even Turkey alone would have a shortfall if reserves are not considered.⁴⁸

The Tigris' flow variations, both seasonal and inter-annual, exceed that of the Euphrates. The record low flow at the Turkish-Iraqi border is a mere 6.2 BCM.⁴⁹ During extremely low volume years, it is theoretically possible that planned Turkish consumption could use up all of the Tigris' water in Turkey, and

⁴⁷Kliot, 144.

⁴⁸The US Army Corps of Engineers.

⁴⁹The US Army Corps of Engineers. Again no year is specified.

leave only those waters that do not originate there, for Iraq. While water from those tributaries constitutes a significant percentage of Tigris in Iraq, they may also be reduced by the same climactic phenomena causing the low flow in Turkey.⁵⁰ This could have devastating effects on Iraqi agriculture and domestic water supply.

Also, while few sources deal with the in-stream water needs of the rivers, a certain amount is necessary in the Tigris-Euphrates Basin for the sole purpose of maintaining the ecological integrity of the system. The US Army Corps of Engineers estimates that a minimum of 9.2 BCM (at the *Shatt al-Arab*) is necessary to transport effluents.⁵¹

2.5 Storage Capabilities

Once all planned projects are completed, the total storage capacity of Turkey, Syria and Iraq's reservoirs will reach 205 BCM. This quantity represents three times the total annual flow of the rivers in the Tigris-Euphrates Basin. Those reserves could be released to compensate for drought or below average annual flows.

The evaporation rate in Iraq and Syria is much higher than in Turkey because of Turkey's more favorable topography and climate. Daniel Hillel, author of *Rivers of Eden*, estimates a 8 BCM loss out of

⁵⁰Himyari, 1984, as cited in US Army Corps of Engineers.

⁵¹The US Army Corps of Engineers.

100 BCM storage in Iraq compared to only a 2 BCM loss out of 90 BCM storage in Turkey.⁵² Syria only stores 15 BCM in its reservoirs, and loses almost 7% annually or 1 BCM. Leakage is another possible source of water loss, but it is impossible to estimate what quantity may be lost to leakage at this time since not all dams have been completed.

Also, in the event of a water shortage in Iraq or Syria, Turkey cannot be counted on to release water from its reservoirs to help make up for that shortfall. Turkey will be constrained by its own need to maintain certain water levels behind its hydroelectric producing dams and to retain water for irrigation. Syria and Iraq would have to depend on their own reservoirs to compensate for periods of drought. But, since many of Turkey's dams produce hydroelectric power, Turkish officials claim that even during the driest months, the Euphrates' flow will only be one third of its annual average.⁵³ This, it is argued, will benefit Syrian and Iraqi agriculture by providing them with adequate water year-round.

2.6 Conclusion

This chapter has discussed, within the limitations

⁵²Daniel Hillel, Rivers of Eden: The Struggle for Water and the Quest for Peace in the Middle East (New York: Oxford University Press, 1994), p. 103.

⁵³Addeane S. Caellegh, "Middle East Water: Vital Resource, Conflict, and Cooperation," in Joyce R. Starr ed., A Shared Destiny: Near East Regional Development and Cooperation (New York: Praeger, 1983), p. 125.

of the available data, what water is available to the Tigris-Euphrates River Basin, and how current plans to use those waters will affect availability in the future. As made evident by this chapter, not enough water exists to carry out planned development projects in the Tigris-Euphrates River Basin, especially in low flow years. The use of stored water may provide marginal relief for seasonal and inter-annual water flow variation. But in the long term, either supply of water will have to increase, or projected demand will need to be reduced.

CHAPTER 3

Aspects of Water Demand in the Tigris-Euphrates Basin

3.1 Introduction

As demands for water from the Tigris-Euphrates system increase, tensions between riparians over available resources will likely intensify. This chapter examines aspects of demand for water, and evaluates where opportunities to reduce that demand may exist.

3.2 Food Security

At the heart of the water scarcity issue is food security. States need to be able to feed their people, and in the arid Middle East this is not easy to do. In her 1991 *Foreign Policy* article, Joyce Starr observes that the actual water crisis in the Middle East is not a conflict over water for water itself, but rather for water as a means for producing food.⁵⁴ This is certainly its most significant dimension. "As populations grow, ways must be found to maintain [reasonably high nutrition levels.] The alternative is increasing hardship and unacceptable political destabilization."⁵⁵

In order to provide those reasonably high

⁵⁴Starr, Covenant, p. 169.

⁵⁵John F. Kolars, "The Southeast Anatolia Project: Will it make Turkey a Major Food Supplier to the Mideast?" *Middle East Executive Reports*, v. 9, no. 9, September 1986.

nutrition levels, states can either produce food for themselves or purchase it from other countries. Currently all three states import significant amounts of food from abroad.⁵⁶ However, relying on imported food is viewed by many states, including Syria and Iraq, as a threat to national security. Further, those states lack the abundant financial resources to buy increased amounts of food from other countries.⁵⁷ Relying on external sources would make them dependent on political relations with other states and to the security of supply routes. Therefore, those states have adopted policies of self-sufficiency to ensure food security. And as discussed above, Turkey, in addition to meeting its own needs, desires to become an exporter of food.

3.3 Demands of Population Growth

The population growth rate for Turkey is a moderately high 2.3%, but in Syria and Iraq population growth rates of 3.6% rank among the highest in the world. In the ten year period from

	<u>1990</u>	<u>2000</u>
Turkey	55.9	67
Syria	12.5	18
Iraq	15.6	26

Figure 3.1 Population (millions), Kliot, p. 153.

⁵⁶Kliot, p. 154.

⁵⁷Currently because of the boycott on Iraqi oil Iraq lacks the money to purchase food from abroad. Once this boycott is lifted Iraq, will again have the ability, if it has the desire, to purchase needed food from abroad.

1990 to 2000 the populations of those three states will increase over 30% (figure 3.1).

Such a high growth rate places strains on the existing water supply, but programs to control population growth do not exist. In fact Iraq has recently been encouraging growth among its population in order to supply its labor force and military with future manpower.⁵⁸ The Syrian government also encourages population growth, despite its obvious problems associated with food and water scarcity. Hillel explains Syria's encouragement of population growth as a belief that "it adds to the country's strength and enhances its claim to leadership of the Arab world."⁵⁹ While there is no evidence that the Turkish government encourages population growth, it is extremely concerned with emigration away from its southeastern provinces. More effective utilization of Tigris-Euphrates water is seen as critical to regional development programs intended to provide employment, raise living standards, and reduce migration to the cities of western Anatolia.

In addition to rapid growth, urbanization puts increased demands on water resources. Urban populations are growing faster than rural populations throughout the Middle East. This puts additional stress on resources because per capita domestic water

⁵⁸Starr, Covenant, p. 147.

⁵⁹Hillel, Rivers of Eden, 106.

demands are higher in the urban areas.⁶⁰ The increased demand may be explained by a higher standard of living as well as by water distribution systems that encourage consumption and wasteful use of water. With population growing much faster than the land can provide farmers with work, many rural inhabitants are fleeing to the cities to find jobs. Fifty percent of Turkey's and Syria's populations and 70% of Iraq's lived in urban areas in 1990.⁶¹

In the GAP region of Turkey, the population 10 million, predominantly Kurdish people, make up 17% of the Turkish population. However they contribute only 4% to the Gross Domestic Product (GDP).⁶² The birth rate there is 3.4% per year, 50% higher than the rest of Turkey, but overall population levels have been declining due to migration to the country's western cities. The nine year old Kurdish uprising which has already claimed over 5,000 lives is a further factor contributing to out-migration.

Most of Syria's population is located in the western part of the country. Aleppo, with a population of 1.5 million, is the only major Syrian city in the vicinity of the Euphrates and frequently suffers from

⁶⁰Wakil, "Sharing the Euphrates," p. 65.

⁶¹US Army Corps of Engineers, p. 4. This trend appears to have reversed as a result of the post-Gulf war boycott on Iraq: Hardan.

⁶²Ercan Ersoy, "Turkey Plans Faster Development in Kurdish Areas" *Reuter European Business Report*, March 2, 1993.

power and water shortages related to the low flow of the Euphrates. The Queick River, which once supported Aleppo, is now completely exploited by Turkey during the summer months.⁶³ By the year 2010, approximately 7.8 million Aleppines are expected to depend on the Euphrates for their water supply.⁶⁴ Damascus and the other Syrian cities will also depend heavily on food produced in the Euphrates Basin. Because of rapidly growing populations, it is unlikely Syria will ever achieve self-sufficiency in food production, despite expansion of the agricultural sector.⁶⁵

While current data about Iraq is extremely difficult to obtain, Adai Hardan reports that in post-Gulf War Iraq, more and more people have turned to agriculture as an alternative to the limited and expensive imported food.⁶⁶ Also, based on 1980's data, only 30% of Iraq's population is actually in the labor force, while the majority of the population is under the age of 15.⁶⁷ Unless Iraq is able to expand greatly in all dimensions of its economy, it will be hard pressed to find work for and support its increasing population.

⁶³Wakil, "Sharing the Euphrates," p. 70.

⁶⁴Wakil, "Sharing the Euphrates," p. 70.

⁶⁵Kliot, p. 157.

⁶⁶Hardan, p. 77.

⁶⁷Joyce Starr, Covenant, p. 147.

3.4 Demands of Agriculture

Crop production is one the most important but consumptive uses of water. "Rapid expansion of irrigated areas is considered a keystone of ... economic development."⁶⁸ This is demonstrated by the fact that 80% of water in the Middle East goes to agriculture. In fact two thirds of all available freshwater used worldwide is consumed by agriculture.⁶⁹ According to the 1994-95 *World Resources*, the portion of freshwater resources used in agriculture is 57% for Turkey, 83% for Syria and 92% for Iraq.⁷⁰ The GAP will cause Turkey's percentage to grow larger because of the planned increased use of irrigation in the GAP region.

Demands of agriculture are closely related to the growing food needs of an increasing population. However, as is the case in the GAP, Turkey plans to increase the production of agriculture in excess of what its population demands. Again, Turkey intends for its GAP region to become the breadbasket of the Middle East, and export food to its more arid neighbors.

⁶⁸Wakil, "Analysis of Future Water Needs for Different Sectors in Syria," Water International, 1993, p. 18.

⁶⁹Peter H. Gleick, "An introduction to global fresh water issues," in Gleick ed. Water in Crisis: A Guide to the World's Fresh Water Resources (New York: Oxford University Press, 1993), p. 6.

⁷⁰World Resources 1994-95, p. 346. The data for Turkey is from 1986, Syria 1976, and Iraq 1970.

3.4.1 Irrigation

Since most areas suitable for rain-fed agriculture have long been exploited, increased emphasis will be placed on irrigation to meet the future demand for food. Irrigation ensures crop yields in dry years and enables farmers to double and in some cases even triple crop.

Traditional methods of irrigation, such as flooding the fields each spring and using gravity flow furrow irrigation are widely used in all three states. Those methods are simple and inexpensive, but allow a great deal of water to be wasted. Surface irrigation is approximately only 50% efficient. Only 50% of the water is actually used by the intended crops, while the other half is lost to evaporation, seepage, or non-agricultural plants. Additionally, fields irrigated by those traditional methods are susceptible to salinization damage when the water evaporates and leaves harmful salts in the soil.

Officials in Turkey and Syria recognize that modern methods to improve efficiency are necessary. But Iraq, with its financial woes, is not likely to modernize in the immediate future. Even Turkey and Syria, because of increased capital costs involved with modernizing irrigation schemes, are slow to implement their plans to modernize irrigation in the Tigris-Euphrates Basin.

Methods of water distribution in the region also encourage waste. In Turkey, farmers are not charged for the volume of water they use, but rather for the quality of land they irrigate. The poorer the soil,

the cheaper the water rights. According to Mr. Hurman Ocakli, Deputy President of the GAP Authority, "the farmers use as much water as they want. It is not even calculated."⁷¹ This sort of uncontrolled water use is incompatible with conservation and efficient use of scarce resources. The Turkish government is not oblivious to that. In fact, they have awarded a consulting contract to a British water engineering firm to tackle the various political, economic and environmental issues associated with water use. But as long as water remains cheap it will be difficult to convince farmers to adopt more efficient methods of water use, and agricultural demand for water in the country will remain high.

The Euphrates is virtually the only water source suitable for irrigation in central and eastern Syria. Syria claims that a third of its people depend on the Euphrates' water for irrigation or domestic consumption. Because of the high level of dependence on agriculture in Syria, water for irrigation is available at no cost to farmers.⁷² Such disregard for the value of water will make it difficult to encourage farmers to be more frugal with its use.

⁷¹John Murray Brown "Turkish Agriculture Approaches Watershed - A Look at a Project to Harness the Tigris and Euphrates for Irrigation" *Financial Times*, April 14, 1993, p. 32.

⁷²Yahia Bakour, "Planning and Management of Water Resources in Syria," Arab Organization for Agricultural Development, Damascus, May 1991, p. 90.

Iraq with a total of 12 million ha of arable land, cultivates only 3 million ha in any one year.⁷³ Irrigation has been practiced in Iraq for the past six millennia, but today irrigation is not even as widespread as it was under the Abbasids over 1000 years ago.⁷⁴ There is a great deal of land which, if irrigated, could help meet the needs of the growing population. But much of this land is plagued by problems of salinity from decades of over-irrigating. By using modern methods of irrigation Iraq could avoid land loss associated with over-irrigating and reclaim land lost to salinity, but in the absence of sufficient financial resources, this is unlikely to occur.

3.4.2 Modernization of Irrigation

Modernization of irrigation usually involves utilization of sprinkler or Low Energy Precision Application (LEPA) irrigation. Water distributed by sprinklers is much less susceptible to evaporation, because it is delivered in controlled amounts to the fields. Nevertheless sprinkler irrigation is only 70% efficient.⁷⁵ But even with a 20% increase in efficiency achieved by using sprinkler irrigation, the amount of water saved could be measured in billions of cubic meters. According to Syrian sources, if

⁷³Peter Beaumont et al. The Middle East: A Geographical Study, (New York: John Wiley and Sons, 1976), p. 331.

⁷⁴Naff and Matson, p. 89.

⁷⁵Hillel, p. 213.

irrigation efficiency can be improved from 60% to 75% the water saved would exceed 2.0 BCM annually.⁷⁶

LEPA irrigation, otherwise known as drip irrigation, is even more efficient than sprinkler irrigation. This method places water in small amounts precisely where it is needed at predetermined times. LEPA irrigation is estimated to be 90-95% efficient, and could potentially halve the volume of water presently required for agriculture.⁷⁷

LEPA irrigation is very expensive because it requires a complex water distribution and regulation systems. For that reason it is not yet widely used in the Tigris-Euphrates Basin. Drip irrigation is however very popular in the Gulf States where abundant oil money has enabled Saudi Arabia to become a wheat exporter, albeit at a cost far above world market prices. Israel too, which has a high GNP, uses LEPA irrigation to grow high value crops.

Modernization of irrigation techniques can be very useful in reducing overall water demand for irrigation, as well as increasing the amount of cultivable land by preventing salinization.

3.5 Domestic Use

Domestic use of water is small when compared with agricultural consumption (figure 3.2), but as population grows and the standard of living increases.

⁷⁶Bakour, p. 58.

⁷⁷Hillel, p. 213.

the gap narrows. For instance, Turkey's domestic use of the Tigris and Euphrates is currently very small. However, total demand in urban areas is expected to increase from 5.9 BCM to 9.0 BCM/year between 1990 and 2000.⁷⁸ If Turkey decides to transfer water from its Tigris or Euphrates reservoirs to its cities that could represent an unforeseen demand on the basin's water.

Syria's domestic water use in 1990 was 0.9 BCM; this amount will more than double by 2010, and by 2030 it will reach almost 5 BCM. Poor management and maintenance resulting in broken water meters and rusty pipes result in waste of potable water in Syria.⁷⁹ Correcting this may enable Syria to stretch its supply of drinking water for some time, but even saving the 30% that is unaccounted for each year may only keep pace with demand for a decade or so.

Turkey	24%
Syria	7%
Iraq	3%

Figure 3.2
Percentage of Total
Withdrawals by
Domestic Sector.
World Resources
1994-95, p. 346.

Baghdad and Mosul are Iraq's two major cities in the vicinity of the Tigris River. They rely heavily on the Tigris' waters as a source of domestic water. Those two cities have experienced shortages of potable water in recent years. The Iraqi urban sector is in urgent need of an expanded and reliable water supply.⁸⁰

⁷⁸Kliot, p. 137.

⁷⁹Naff and Matson, p. 97.

⁸⁰Kliot, p. 147.

3.6 Industry

The quantities of water used for industry in Turkey, Syria and Iraq are comparable to the amounts used for domestic purposes (figure 3.3). However, industrial withdrawals represented in figure 3.3 do not accurately reflect the industrial use of the Tigris or Euphrates. The use of those rivers for industry is much lower, and by 2040, withdrawals from those rivers will dramatically increase.

Turkey	19%
Syria	10%
Iraq	5%

Figure 3.3
Percentage of Total
Withdrawals by
Industrial Sector,
World Resources
1994-95, p. 346.

Turkey, Syria, and most likely Iraq, view industrial development as key to future prosperity. Since the 'value added' by water used in industry is greater than that for agriculture, it is logical that industry should receive a high priority. Despite policies of self-sufficiency, it is unlikely that states would chose to pursue less productive agricultural instead of industrial uses.

3.6.1 Hydroelectric Power Production

The generation of hydroelectric power is the least consumptive use of water. By collecting water in huge reservoirs behind dams, a great amount of energy can be produced when the water is released through power generators. Hydroelectric power is considered one of the cheapest sources of power, especially when the opportunity cost of oil (that could otherwise be sold)

is taken into account.

Generation of hydroelectric power is important for Turkey's future because of its dearth of fossil fuel resources. Syria too, depends on hydroelectric power for 25% of its total installed electric capacity.⁸¹ "More than it needs irrigation water [...] Syria needs the Euphrates waters for hydroelectric power as a cheap and non-depleting source of energy."⁸²

Iraq relies primarily on its vast reserves of oil for power production, but that country is also beginning to develop hydroelectric plants on the Tigris and its tributaries. In the course of the next 100 years, hydro-electric power will steadily gain importance in the Middle East as oil reserves are reduced. The Middle Eastern Power Grid, a multinational agreement to export surplus hydro-electricity from Turkey to Iraq, Egypt, Jordan and Syria is evidence of how those states foresee being able to meet their power needs in the future.

3.7 Conclusion

Since populations are expanding in Turkey, Iraq and Syria all three states need to increase their degree of food security and *desire* to increase, or at least maintain their standard of living. In order to do this the demand for water from agricultural, industrial, and domestic users will increase.

⁸¹EIU - 1992c Syria et Monde Arab, Aug 1989, cited in Kliot p. 142.

⁸²Kliot, p. 142.

Because of growing populations and urbanization, domestic needs for water will increase rapidly. If measures are taken to curb water loss from leaky pipes, the increase in this demand can be slowed. However, in the long-term, larger volumes of water will still be necessary to meet the domestic needs of those populations.

Considering Turkey and Syria's plans for massive industrial development, decreasing industrial consumption is unlikely. As water is needed for hydroelectric production to support the planned industry, its release may become increasingly dependent on the need for electricity. Because Syria and Iraq cannot depend on Turkish release of waters to coincide with their needs for agriculture, they may come to rely on storing their own waters for irrigation and buying electricity from Turkish generators. Since both have accepted the Middle East Power Grid, it can be inferred that they have also come to the conclusion that buying power from Turkey may be an inevitable prospect.

Since agriculture uses such a large percentage of the total water resources of the Basin, therein lies the best opportunity for reducing demand. By modernizing irrigation alone, billions of cubic meters of water may be made available for other uses or for increasing agricultural production. Furthermore, if extensive irrigation plans and policies of self-sufficiency are abandoned in favor of more limited cultivation of high value crops, even more water would be available. However, the question of how much water may be made available in the future depends on many

unknown factors, and any estimate of possible savings and reallocation between and among users is highly speculative.

CHAPTER 4

The Nature of Riparian Rights

4.1 Introduction

Differing perceptions of riparian rights serve as major obstacles to peaceful resolution of the water disputes in the Tigris-Euphrates Basin. Because each state varies in its perception, opposing views often appear to be in violation of perceived norms of justice.

It would be convenient if a codified law of water rights existed, riparians could argue their views before a judge who also had the power to enforce a decision. However, no such mechanism exists in the area of international water law. Moreover, the United Nations, the closest thing to a world government, which set out in 1970 to codify the laws of international watercourses, has not yet been able to ratify those articles.

In this chapter, I will explore the extent to which riparian rights can be defined by international law. In doing so I will explain several principles of the law and demonstrate how they may be applied. Finally, I will evaluate the effectiveness of those principles in resolving disputes and draw some parallels to the Tigris-Euphrates Region.

4.2 Principles

States are likely to lay claim to water based on a wide variety of legal principles. For example, an upper riparian may claim *absolute sovereignty* over the

resources in its country. The US first espoused this argument in support of a 1895 decision to use the waters of the Rio Grande without any regard for its downstream neighbor, Mexico. However, the US itself later repudiated this doctrine during a dispute with Canada over the Columbia River when the US was the downstream riparian. *Riparian right* or *limited sovereignty*, a principle often espoused by downstream riparians, states that all riparians sharing an international water course have equal rights to that water. *Absolute territorial integrity* is a principle espoused by those who argue that any alteration of a river's natural regime would have harmful effects. *Historical right*, also called *prior appropriation* or *first in use*, says that the earliest user of water ought to be allowed to continue the use of that water. Legal specialists currently place reduced emphasis on *historical right*, and instead accept *need* as a more valid principle in determining right.⁸³ Finally, *optimal development*, or *co-riparian communalism* is based on the belief that a basin should be developed optimally as a single hydrological unit. Jagat Mehta, former Foreign Secretary of the Government of India, advocated operating under this principle in the Indus Basin. But because of insurmountable political differences, the Indus Treaty, concluded in 1960, was based on a partitioning the waters rather than managing

⁸³Kliot, p. 270-1.

them jointly and optimally.⁸⁴

Turkish leaders have espoused *absolute integrity* in the past, by comparing the water in the country's territory with oil in Iraq's. Iraq, the furthest downstream riparian on both rivers stood behind *absolute territorial integrity* while Syria advocated the doctrine of *riparian right*.⁸⁵

When states choose to support mutually contradictory principles, the only plausible solution becomes a negotiated or mediated compromise.⁸⁶ In the absence of a negotiated settlement the upstream riparian has a natural power advantage. However, if the downstream riparian is militarily or economically stronger it can overcome this advantage. For example, Egypt has historically been able to dictate water use to the upstream Nile riparians because of its superior military strength over Ethiopia and Sudan. In the Tigris-Euphrates Basin Turkey, both because of its upstream position and greater military power, holds the undisputed upper hand.

4.3 History of Riparian Rights

Riparian rights have a long history in the Middle East. Hillel cites examples of *fatwa* from Islamic scholars throughout the history and literature of the

⁸⁴Jagat Mehta, "The Indus Water Treaty: A Case Study in the Resolution of an International River Basin Conflict," *Natural Resources Forum*, 1988, p. 69.

⁸⁵Kliot, p. 271.

⁸⁶Hillel, p. 270.

Middle East, and concludes that principles such as *upper riparian position, prior use, not causing harm and need*, have all been supported with reference to water rights.⁸⁷ He establishes that, throughout the history of the region, the resource has been viewed as a communal property.

In a modern interpretation of these traditions, nearly all the states of the Middle East have established the principle that water is a national resource to be regulated by collective interests rather than given to unbridled private ownership. Its proper management and use are in most cases the responsibility of the state, which can grant rights of use but not permanent ownership to individuals and groups. However, the region's traditions have not yet been extended to international rivalries over water rights.⁸⁸

Hillel states that "ideally, riparian states should enter into an agreement for coordinated or joint management of a shared river so as to protect the needs and interests of all the riparians."⁸⁹ However, he points out the difficulty in applying this ideal, especially when states have competing interests.

Despite the fact that no international body can compel a sovereign state to submit itself to a ruling of international law, several attempts have been made to establish universal principles for water bodies.

⁸⁷Hillel, p. 267-8.

⁸⁸Hillel, p. 269.

⁸⁹Hillel, p. 269.

4.4 Attempts to Codify Principles into International Law

The United Nations, through the International Law Association (ILA), has tried to establish principles of general applicability concerning international watercourses. These principles are embodied in the Helsinki Rules, published in 1966. The Helsinki Rules state that a watercourse should be considered in terms of its drainage basin or catchment area. Article IV defines that within this area "each basin state is entitled, within its territory, to a reasonable and equitable share in the beneficial uses of the water."⁹⁰ Article V enumerates eleven factors on which this "reasonable and equitable share" are to be based.⁹¹

However, in their attempt to remain site specific the Helsinki Rules have left certain terms undefined, complicating the Rules' interpretation. For example,

⁹⁰Helsinki Rules Chapter 2, Article IV, as cited in Kliot, p. 277.

⁹¹Those factors include: a) geography, to include the extent of the drainage basin in the territory of each basin state; b) contribution of water by each state to the basin; c) climate affecting the water resources of the basin; d) past utilization of basin waters; e) economic and social needs of each basin state; f) populations of each basin state depending on basin waters; g) comparative costs of alternative means of satisfying economic and social needs of each basin state; h) availability of other resources; i) avoidance of unnecessary waste in utilization of basin waters; j) practicability of compensation to one or more of the co-basin states as a means of resolving conflicts among users; and k) degree to which needs of a basin state may be satisfied, without causing substantial injury to a co-basin state.

what is reasonable, what is equitable? In addition to lacking specifics, the Helsinki Rules have been called ambiguous because they fail to establish how each factor is to be weighed against the other factors.⁹²

While the Helsinki Rules provide a promising start toward providing a global code to govern world water resource management, the International Law Commission (ILC) has attempted fashion those principles into a convention that could be ratified by the world's governments. The text of the ILC emphasizes that sharing should not be restricted to quantity apportionment, and that attaining *optimum utilization* should be the ultimate goal in international water management.⁹³ Nevertheless, the ILC Draft is no less ambiguous than the Helsinki Rules, and also encourages states to arrive at a mutual understanding through negotiated agreement to settle water disputes.⁹⁴

Hillel evaluates the importance of documents like the Helsinki Rules and the ILC Draft as important, despite being vague, because "they tend to shift international water disputes from contests of power to considerations of fair rights and mutual obligations."⁹⁵

⁹²Hillel, p. 272.

⁹³Dante A. Caponera, "Patterns of Cooperation in International Water Law: Principles and Institutions," *International Water Law*, July 1985, p. 566-7.

⁹⁴Caponera, "Patterns," p. 568.

⁹⁵Hillel, p. 272.

4.5 Equitable Utilization

Today, only one doctrine, *equitable utilization*, "has gradually emerged as the preferred approach among legal scholars, international law organizations, and state litigants."⁹⁶ Ironically, because of its ambiguity, few have found fault with it. The doctrine does not imply equal division of the water, in fact, since it refers to the equitable use of the 'benefits of water,' one can infer that an upstream state could use all of the water for producing electricity and food if it gives a portion of the electricity and food to its downstream neighbor. However in the end, interpretation of equitable utilization will come down to negotiations along the lines set forth in the Helsinki Rules, and will inevitably involve other political and economic issues.⁹⁷

Based on the Helsinki Rules' interpretation of *equitable utilization*, Syria and Iraq lay claim to more water than the current 500m³/s agreement, while Turkey maintains that its Three Stage Plan should be accepted because of their adherence with the ILC's text concerning *optimal utilization*. Because gross ambiguities exist in the Helsinki Rules, which were intended to make their application site specific, one cannot immediately discount the validity of either claim.

⁹⁶Thomas Naff, "Water: That Peculiar Substance," *Research and Exploration*, Water Issue, 1993, p. 14.

⁹⁷Hillel, p. 277.

4.6 Settlement of Disputes

The International Court of Justice will not hear a case unless each disputant freely submits itself to adjudication. And once the court renders a decision, it is impossible to enforce the ruling upon a sovereign state. Because Syria, Iraq and Turkey view water rights as crucial to their futures, it is unlikely that they will agree to do this. Therefore, a negotiated or mediated settlement is the only realistic settlement option.

However, while states cannot be brought before a tribunal to settle differences, they do have some incentive to act in accordance with principles of international law.

"The existence of the various declarations and provisionally approved articles concerning the use of international river basins has indeed helped to create a body of conventions (if not customary law) which inhibit some of the worst aspects of sovereign behavior by upstream, and in some cases, downstream riparians."⁹⁸

David LeMarquand, author of *International Rivers: The Politics of Cooperation*, points out that "the concern for national image may be one of the most important factors in deciding how [states] deal with international water issues."⁹⁹ He goes on show that

⁹⁸Peter Rogers, "The Value of Cooperation in Resolving International River Basin Disputes," *Natural Resources Forum*, May 1993, p. 123.

⁹⁹David G. LeMarquand, International Rivers: The Politics of Cooperation, (Vancouver: Westwater Research Center, 1977), p. 12.

the United States' decision to build a desalting plant on the Lower Colorado River was largely influenced by a desire to avoid a negative image of a large country pursuing its national interest without regard for its poorer neighbor. While Turkey is not the United States, it is susceptible to the influence of world opinion because of its political and economic ties to the West. Therefore, "non-binding international legal principles can be important factors enabling countries to enter into negotiations."¹⁰⁰

LeMarquand also points out that *linkage* to other bilateral or multilateral issues may help extract water concessions from obstinate riparians.¹⁰¹ While linkage may occur within a basin itself between disputants (such as Turkey linking 500m³/s flow to Syria's withdrawal of support from the PKK), it is most prominent when some sort of concession is linked to large amounts of financial aid (such as the settlement of the Indus River dispute which was linked to large amounts of U.S. and World Bank aid).

4.7 Conclusion

Although riparians rarely resort to legal measures to solve trans-boundary water disputes, partisans often adopt the legal principles that best suit their interests.¹⁰² But because of external factors, such as

¹⁰⁰Rogers, p. 123.

¹⁰¹LeMarquand, p. 13.

¹⁰²Naff, 14.

image and linkage, they may be convinced to enter into negotiations. And the results of those negotiation often correspond to the broad framework of international legal principles.

Stephen McCaffrey points out that, "[h]istory has shown time and time again that serious violations of international law entail costs, those are often not easily borne."¹⁰³ Another legal scholar maintains, "almost all nations observe almost all principles of international law and almost all of their obligations almost all of the time."¹⁰⁴

If solutions can be proposed which coincide with their perceived notions of justice, the prospect of reaching a negotiated settlement in the Tigris-Euphrates Basin might be a realistic option. Because we have seen that third party states and international organizations have provided financial incentives in the past to help resolve water rights disputes in terms of a just settlement, availability of such funds may be crucial to such a resolution. Also, since past Turkish, Syrian, and Iraqi agreements have been linked to other factors (ie. the PKK), it is likely that a future settlement may similarly involve other linkages.

¹⁰³Stephen C. McCaffrey, "Water Politics in International Law," in Gleick ed., p. 97.

¹⁰⁴L. Henkin, How Nations Behave, (New York: Columbia University Press, 1979), cited in Gleick ed., p. 97.

CHAPTER 5
SOLUTIONS FOR THE FUTURE

For one thing, the problem today is not simply to find ways of ameliorating a supply problem but to do so in ways that are simultaneously economically efficient, ecologically responsible, and politically acceptable. Attention to one dimension alone is unlikely to be helpful.

-David Brooks¹⁰⁵

5.1 Introduction

As has been established earlier, failure to find a solution to the dispute over water in the Tigris-Euphrates Basin will prevent some states from meeting their development goals, possibly resulting in declining standards of living, social upheaval and even war. The previous chapter concludes that the most realistic vehicle for reaching a permanent solution is a negotiated settlement based on principles of international law, possibly linked to other political and economic issues. Therefore, this chapter will examine various solutions that have been proposed to the Tigris-Euphrates Basin dispute, judge their advantages and disadvantages, and indicate how they may succeed or fail in meeting the needs of Turkey, Syria and Iraq.

I have divided solutions into three broad categories based on the degree of cooperation required

¹⁰⁵David B. Brooks, "Adjusting the Flow: Two Comments on the Middle East Water Crisis," *Water International*, March 1993, p. 36.

to attain them. These solutions include 1) freshwater supply enhancement, 2) sharing, and 3) cooperation. Freshwater supply enhancement can be pursued independently. Sharing requires a tacit approval of the upstream states not to use water allocated to downstream riparians. And cooperation opens the way to various solutions involving the *optimal utilization* of water resources.

Two fundamental questions must be answered if a comprehensive long-term solution to the water scarcity issue in the Tigris-Euphrates Basin is to be solved. First is 'how will the water, or the benefits of water, be distributed?' and second is 'how will the water be used?' Supply enhancement, sharing and cooperation overlap each other to varying degrees in answering those questions but are addressed separately for clarity's sake. The eventual answer to the water question may be a combination of these solutions, or a process characterized by an evolution through each of these options, from sabre rattling to cooperation.

5.2 Fresh Water Supply Enhancement Options

No matter how water is shared, continued population growth will force states to search for new sources of fresh water. Through wastewater reclamation, governments can provide their farmers with a source of water for irrigation. Improved irrigation schemes can create usable water from otherwise wasted runoff. Desalinization can provide states with the potable water for domestic and industrial use.

5.2.1 Water Reuse

Wastewater reuse has been identified as having a potentially significant role in alleviating the quantitative and qualitative constraints on regional water resources.¹⁰⁶ Wastewater reclamation will occur primarily in the urban areas because of large quantities of wastewaters and sewer systems to facilitate the collection of wastewater.¹⁰⁷ For that reason Aleppo, Mosul and Baghdad are the best sites for implementing wastewater reclamation schemes. High costs and questions of health standards associated with wastewater reclamation will have to be addressed before this can be an efficient way to provide potable and irrigation water on a large scale.

While wastewater reclamation is most useful in urban areas, and therefore of limited use in the Tigris-Euphrates Basin (except in Aleppo, Mosul and Baghdad), reuse of agricultural water might greatly improve the efficiency with which farmers use existing supplies. One technique, known as sequential reuse, involves blending saline runoff with better quality water to increase the total quantities of acceptable quality.¹⁰⁸ Sequential reuse can also involve reuse of waters previously used in industry or for domestic

¹⁰⁶Nadim Khouri, "Wastewater Reuse Implementation in Selected Countries of the Middle East and North Africa," *Canadian Journal of Development Studies*, Special Issue, 1992, p. 132.

¹⁰⁷Khouri, p. 133.

¹⁰⁸Khouri, p. 138.

purposes. Sequential reuse is inexpensive and because it requires little energy, it may be employed effectively to ensure water is used less wastefully.

5.2.2 Improved Irrigation Techniques

I will not discuss the specific methods of improving irrigation, already considered in chapter three. However, those techniques, sprinkler and LEPA irrigation, are extremely important to conserving water resources. They are dependent on start up costs and energy expenditure but provide a promising opportunity to increasing the productive use of the available water in the Tigris-Euphrates Basin.

5.2.3 Desalinization

Desalinization of seawater is probably the best long term solution to the water scarcity problem.¹⁰⁹ Only through desalinization can states 'create' fresh water out of otherwise unusable, but abundant sea water. Of the several types of desalinization methods including electrolysis and reverse osmosis, the most widely used method is distillation. Because distillation involves the vaporization of the saline source liquid, it is more efficient when used in conjunction with power-generating plants, where heat produced is otherwise wasted.

Because seawater is abundant this option is not limited by the availability of water. The level of technology and availability of finances limit

¹⁰⁹Hillel, p. 251.

desalinization since it is so energy intensive. One problem with desalinating seawater for agriculture is that the seashores' of Turkey, Iraq and Syria are far from where each country plans to irrigate the land. Transport of water would add a great deal to the cost of desalinization.

Because of the large amounts of energy required, the Persian Gulf States, have taken the lead in world sea water desalinization. Iraq, because of its oil reserves, could pursue desalinization more effectively than Turkey or Syria.

The eventual exhaustion of fossil fuels is a problem for desalinization. Manuel Schiffler analyzes the costs for experimental desalinization schemes in Jordan. Employing either solar or electrical energy for desalinization are prohibitively expensive today. Each method costs \$10 and \$5 per cubic meter respectively. Fossil fuel for desalination is cheaper at \$1.50-3.00 per cubic meter at current oil prices.¹¹⁰ Even so, desalinization costs would have to be reduced greatly, to near \$.40 per cubic meter, to justify its being used for agriculture.¹¹¹ The price countries are willing to pay will be directly related to their need for water and their need for energy. Therefore, Syria, with its frequent energy shortages, would be an

¹¹⁰Manuel Schiffler, "Sustainable Development of Water Resources in Jordan: Ecological and Economic Aspects in a Long-Term Perspective," in Bağış ed., p. 352.

¹¹¹Hillel, p. 254.

unlikely candidate to pursue desalinization. Future advances in technology are necessary to make desalinization a viable solution to the Middle East's water crisis.

5.3 Sharing Options

Simple sharing, merely dividing a quantity of water into known portions or percentage shares, can be very inexpensive; in principle, all that is required is a piece of paper on which to write an agreement allocating water between riparians. On the other hand, sharing can be expensive if it involves complicated water transfer arrangements, especially inter-basin transfers, such as the proposed Peace-Pipeline. A tax on water use, receiving international aid or encouraging private investment could effectively address this issue of increased expense.

Officials in Syria and Iraq currently advocate sharing of the Tigris-Euphrates waters. The present temporary agreement between Turkey and Syria for a $500\text{m}^3/\text{s}$ average flow on the Euphrates is an example of a sharing agreement. Syria and Iraq argue for receiving a larger share, $700\text{m}^3/\text{s}$, from Turkey. They argue that the approach falls within the principle of *equitable utilization* as it is established in the Helsinki Rules. But the specific amount of water remains a point of contention in part because of the ambiguity and lack of specificity in the Helsinki Rules. Further, determination of appropriate shares of the Euphrates is complicated by a lack of reliable

data.¹¹²

Sharing has the advantage of determining once and for all the deserved share of water for each riparian state. A treaty may set specific amounts allocated to each state, or may establish criteria (contribution, population, efficient use, need, etc...) on which water distribution is based. Once a state's share of water ownership has been determined, it can work independently, free of other states' claims, to improve efficiency and develop its water resources. This is an attractive option to states that have not shown a great propensity to cooperate and harbor a distrust of each other. In the case of Iraq, Syria and Turkey, this could go a long way toward preserving regional stability, a cornerstone of development.

Because Turkey maintains proprietary rights to all the water that falls within its territory, it has summarily refused to cede rights to lower riparians. Present agreements, whereby Turkey guarantees a minimum flow to Syria and Iraq, are based on Turkey's 'good will,' not on any Syrian or Iraqi right to those waters. A Turkish official once characterized the water distribution problem by saying, "We give the [Syrians and Iraqis] the water -- they can't share it."¹¹³ That point of view shows clear disregard of

¹¹²Turan, Ilter, "Turkey and the Middle East, Problems and Solutions," *Water International*, v.18, 1993, p. 28.

¹¹³Amikam Nachmani, "The Politics of Water in the Middle East: The Current Situation Imaginary and Practical Solutions," in Bağış ed., p. 314.

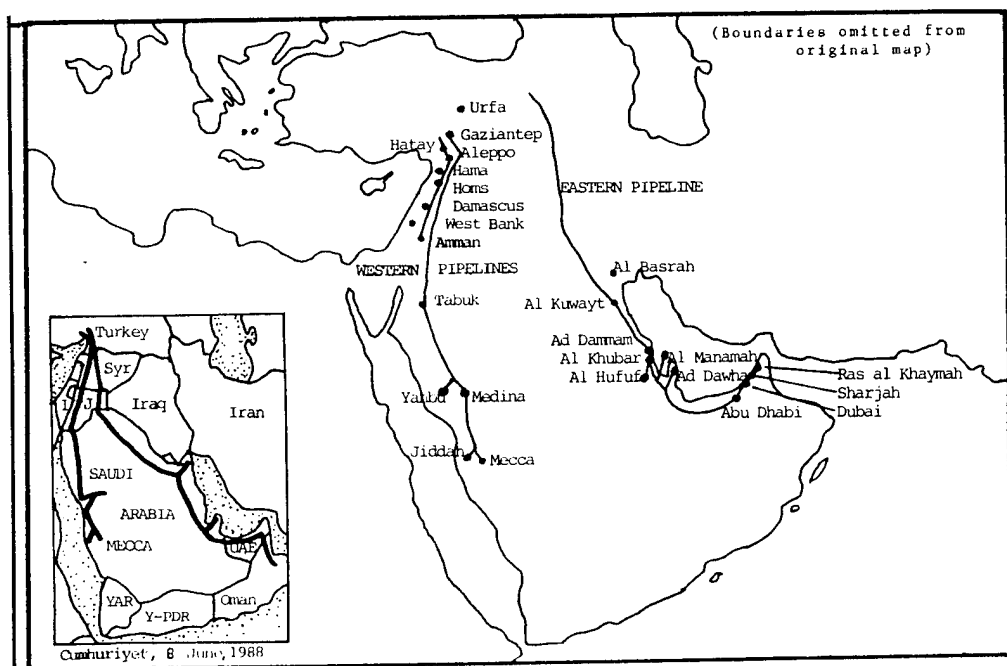
international law, and will not withstand the long term litmus test of world opinion. Only through negotiations, perhaps with linkages to aid or other political concessions would Turkey, like India in 1960, accept an agreement on dividing the Tigris-Euphrates waters.

Sharing by itself is only a temporary solution. "Dividing up a scarce resource among the users does not alleviate scarcity, irrespective of how equitable the allocation procedure is."¹¹⁴ Water sharing need not only be in the form of simple allocation of the Basin's rivers. Transfer from water sources outside the Basin has the advantage of increasing water availability by bringing it to where it can be used more effectively, but it still involves the sharing of water between states.

5.3.1 Water Transfer Schemes

Large scale water transfer schemes such as the Peace Pipeline and Peace Canal have been proposed as possible solutions to the overall Middle East water problem. Turkey is one of only two states in the Middle East having a water surplus, and the only with enough surplus water to consider exporting it. The ability to move water from one place to another can provide needed water to users who are not located near any naturally occurring, or otherwise sufficient source. Water transfer is limited by finances, geography and distance. It is also based on the

¹¹⁴Kut, p. 15.



Map 5.1 Peace Pipeline. Kolars and Mitchell, p. 290.

availability of otherwise unused waters.

But Middle Eastern states' perceived need for water security is perhaps the largest obstacle to implementation of water transfer schemes. As with food, states are reluctant to acquiesce in becoming dependent on a water source that traverses the territory of another state, especially in a region as volatile as the Middle East. Currently, Turkey supports construction of a Peace Pipeline through which it would be able to generate revenue by selling water from its under-utilized sources.

5.3.1.1 Peace Pipeline

One of the most heralded water transfer schemes,

since its announcement by Turkish Prime Minister Turgüt Özal in 1987, is the Peace Pipeline. Several proposals have evolved under the title 'Peace Pipeline.' All involve some variation of a network of pipes to carry water from Turkey's Ceyhan and Seyhan Rivers to other nations in the Middle East (map 5.1). The Peace Pipeline is normally associated with a Turkish-Israeli conduit providing water for Syria and Jordan as well, but other proposals have included Iraq and the Gulf States on an eastern branch of the Pipeline.

According to current estimates, supply of water provided through the Peace Pipeline would be limited to around 2.2 BCM per year.¹¹⁵ The estimated cost of the project is \$10-20 billion, or more, depending on how far the water needs to be transported. Turkey would recoup those costs by charging a fee. For example, at \$0.84 per cubic meter, a price experts estimate that Israel may pay, Turkey could earn \$1.68 billion per year.¹¹⁶ Turkey would not bear the costs of building the Peace Pipeline alone, but could count on contributions from western states and international organizations, all which have an interest in Middle East stability.

¹¹⁵Boaz Wachtel, "The Peace Canal Plan: A New Model for the Distribution and Management of Water Resources and a Catalyst for Cooperation in the Middle East," in Bağış ed., p. 391.

¹¹⁶Randy deShazo and John W. Sutherlin, "Reassessing the Middle Eastern 'Peace Pipeline' in the Aftermath of the Gaza-Jericho Agreements", Paper Presented at the University of New Orleans, July 20, 1994.

Paying for water from Turkey delivered through the Peace Pipeline might prove difficult for the Syrians to accept. Although it would be less expensive than desalinization, for Syria to pay for water to supplement what it loses in the Euphrates Basin would be an admission of Turkish proprietary rights to the Euphrates waters. On the other hand, in a hypothetical scenario where, in exchange for the water Turkey takes from the Euphrates, it delivers water to Syria's population centers (via pipeline), Syria may be more agreeable. Turkey would benefit by resolving the Euphrates dispute, while Syria would obtain water and/or electricity for its population and industrial centers.

A variation of the Peace Pipeline that would involve transporting water via the Euphrates has been suggested by Boaz Wachtel, an Israeli hydrologist. Under this proposal water from behind the Aslantas Dam and Ceyhan Dam, where two reservoirs hold waters of the Ceyhan and Şeyhan rivers, water could be transported to the Euphrates along the Düziçi-Gaziantep Highway. Those additional waters would be used in the Euphrates Basin or alternatively transferred from the Euphrates via another pipeline to supply Jordan and Israel. Very little attention has been given to the Peace Canal idea, but it may provide Turkey a way of maximizing its hydroelectric production and irrigation needs while also maintaining stability among its southern neighbors.

5.3.1.2 Tharthar Canal

Iraq's Tharthar Canal and reservoir link the Euphrates and Tigris Rivers to the north of Baghdad. If Iraq could be convinced to treat the Tigris-Euphrates Basin as a single hydrological unit, it could minimize the effects of Syrian withdrawals from the Euphrates by transferring water through that canal from the Tigris. Kliot concludes that this may be the best option for an equitable distribution of Tigris-Euphrates waters throughout the Basin. Of course, this conclusion assumes that there will be sufficient water in the Tigris available to supplement the Euphrates.

Supplemental water supply from outside the Basin provides a greater available total volume than simple sharing of the Basin's water, but it does not offer a long-term solution. A comprehensive long-term solution must include creating new fresh water sources and/or conservation and efficient use of existing resources. Since desalinization and water transfer are expensive processes, conservation and optimal utilization of existing water resources are essential in assuring the maximum benefit at the lowest possible cost.

5.4 Cooperative Management

Hillel proposes that the ideal solution for the most efficient use of water is joint development of an integrated management scheme rather than development of competitive schemes.¹¹⁷ There are many obstacles to joint development, but there are many rewards too. In

¹¹⁷Hillel, p. 274.

the long run, the need for those rewards may outweigh the costs of overcoming those obstacles. Wolf and Ross point out the

"[w]ater policy in the region is presently drawn up within the boundaries of a nation, rather than within those of a watershed. Because the flow of water does not respect the political boundaries, it should be clear that regional management, at the watershed level at least, would be a much more efficient approach. In fact, the only point on which the water policy analyses surveyed here do agree is on the need for planned water sharing and joint water development, as Eric Johnston envisioned 35 years ago."¹¹⁸

While they are specifically referring to the Jordan River Basin, the same holds true about the Tigris-Euphrates Basin. If political obstacles could be overcome, water could be used more efficiently. For example, rather than having competing storage facilities along the Euphrates river in each state, the same goal could be more efficiently accomplished if most water were stored in Turkish territory where the advantages of climate and topography could be used to minimize evaporation.

Advantages of cooperation include the possibility that water resource can be optimally utilized from an economic point of view. This means the implementation of *allocative efficiency* on a basin-wide scale. *Allocative efficiency* leads to "the utilisation of water first in the economic sectors which bring the

¹¹⁸A. Wolf and J. Ross "The impact of scarce water resources on the Arab-Israeli conflict" *Natural Resources Journal*, vol 32, p. 954.

best returns to water - that is in industry and services rather than in agriculture and secondly within each sector in the productive activities which generate sound economic returns."¹¹⁹ This will increase the income of those states and enable them to buy food from abroad more cheaply than they can produce it themselves. However, this would mean abandoning goals of self-sufficiency. The three states could also pool their resources and financing in order to maximize their development capability. For allocative efficiency to be effective, trade barriers and restrictions would also need to be removed from between Turkey, Iraq and Syria. That way, finished products could flow across borders as easily as water. Each state having a stake in each other's development projects would undoubtedly lead to greater regional stability, which in turn would encourage foreign aid and investment.

5.4.1 Linking Water with its Economic Value

There have been several suggestions to link water with its economic value. This would reduce water waste while encouraging the growth of economically competitive endeavors. Ilter Turan, Professor of Political Science at Istanbul University, recommends giving consumers of the Tigris-Euphrates waters cost-related incentives to use the resource more

¹¹⁹J. A. Allan, "Water in the Arab Middle East: Availability and Management Options." in Bağış ed., p. 157.

efficiently. To this end, he recommends that water pricing policies bear a relationship to the costs of making that water available to the user. Further, he suggests pricing water progressively to give heavy users a stronger incentive to conserve. Finally, he proposes a regional lending agency be established, perhaps under the auspices of the U.N., to make capital available to users who want to promote greater efficiency.¹²⁰

Mawan Haddad proposes a Regional Water Bank (RWB) as a solution to the entire Middle East water problem. He suggests that water ownership be determined by contribution, holding percentage or negotiated settlement. The RWB would be responsible for "all water works related to water storage, allocation, pricing, release and timing, and delivery networks."¹²¹ Haddad suggests that water should be priced based on costs of planning, design, construction, water loss, and interest on borrowed funds. Price would also differ from place to place based on the costs of water transfer.

The obvious flaw in any plan to allocate water according to the ability to pay for it is that a precondition on an agreement on water rights. Until the riparians can arrive at definition of who has a

¹²⁰Ilter Turan, "Turkey and the Middle East, problems and Solutions," *Water International*, v. 18, 1993, p. 27.

¹²¹Marwan Haddad, "An Approach for Regional Management of Water Shortages in the Middle East," in Bağış ed., p. 73.

right to what, cooperation will be impossible.

5.4.2 Turkey's Three Stage Plan

The Turkish government has proposed a three stage plan for the optimum, equitable, and reasonable utilization of the transboundary watercourses on the Tigris-Euphrates Basin. The components of this plan include: 1) inventory studies for water resources, 2) inventory studies for land resources, and 3) evaluation of water and land resources.¹²² Turkey claims that this plan is fashioned in the spirit of *optimal utilization* as stated in the ILC draft.

The first stage of Turkey's plan involves taking readings at gauging stations in Turkey, Iraq and Syria on both the Tigris and Euphrates Rivers, as well as exchanging data on evaporation, temperature, rainfall, and snowfall at the representative stations. After analyzing the data, the three states would calculate the water uses and losses at the various sites. The second stage involves an exchange of information about soil classification and drainage criteria. Experts from each state would evaluate conditions at the various irrigation projects. Those experts would study crop patterns, soil classification and drainage conditions and determine irrigation and leaching water requirements. During the third stage, a plan would be developed to determine irrigation type and systems with the goal of minimizing water losses, and possibilities for rehabilitation and modernization. The experts

¹²²Turan, p. 28.

would set up a simulation model to analyze and balance water demand and supply, and consider water transfer opportunities for the Tigris to Euphrates.

Turkey's plan assumes that, if the appropriate data are known, and the water is managed properly on the basis of accurate information, there is enough water in the Tigris-Euphrates Basin for the foreseeable future. Although Turkey's plan tackles the problem of determining accurate data and calls for experts to determine the most efficient uses of the Tigris-Euphrates waters, it lacks any realistic incentive for Iraq and Syria to participate. Because they view acceptance of Turkey's plan as a compromise to their sovereignty, Syria and Iraq have so far rejected the plan.

Obviously, Turkey believes that it has the best soils for irrigated agriculture, and therefore would be the choice of experts for implementing agricultural projects over territories in Syria or Iraq. The Turkish plan implies that because Syria and Iraq employ wasteful uses of water, by optimally managing the Basin's water resources, all of the needs of the Basin could be met. Turkey may pursue the goals of the GAP, with or without its 'plan,' if no other settlement is reached. However, Turkey would prefer to associate its use of the Euphrates and Tigris waters with some form of international legitimacy, thereby enabling it to receive future World Bank aid for any new Euphrates development projects.

The major impediment to cooperation and coordinated management is, of course, that states in

the Middle East have long histories of distrust, and are not immediately disposed to cooperate with their neighbors. Many historical, cultural, linguistic, religious and political factors need to be overcome before states are ready to cooperate fully with each other. Need for water security may eventually help overcome those factors. As is the case regarding the sharing of resources, lack of accurate data plays a significant role affecting the ability and willingness of states to cooperate. Even in full blown cooperative development projects, states are likely to analyze their results in zero-sum terms. Thus, the most important question which needs to be resolved regarding cooperative development is that of the distribution of benefits. Syria and Iraq are unlikely to take part in joint development projects unless they are guaranteed tangible benefits on their own territories. Political wrangling could compromise *optimal utilization*. Thus, *optimal utilization* should be a goal which is pursued incrementally over many years.

5.5 Lack of a Solution - War

While discussing potential solutions to the impending water crisis in the Tigris-Euphrates Basin, war cannot be overlooked as the most predicted and, to some, the most likely outcome. War or some form of military conflict is likely if no other solution is reached. Thomas Homer-Dixon suggests that where resources are essential for human survival, and can be easily seized and controlled, there is the potential

for conflict leading to war.¹²³ Along with fish and agriculturally productive land, water is described by Homer-Dixon as one such resource.

War is an expensive alternative. The 1990-91 Gulf War against Iraq cost in excess of \$50 billion and failed to destroy Iraq's military or dislodge its leader. Compared to the \$30 billion GAP, \$10 billion Peace Pipeline, or even less expensive desalinization projects, the Persian Gulf War was far more expensive. A conflict over the headwaters of the Tigris or Euphrates waters would likely be costly, and last longer than Operations Desert Shield and Storm. Neither Turkey, Iraq or Syria could afford to bear such costs. Even cost estimates of the recent Turkish incursion into Northern Iraq are between \$715 million and \$2.5 billion after only three days.¹²⁴

Turkey, Iraq and Syria could pursue alternative methods of increasing the water supply instead of preparing for war over that resource. For example:

"[...]the cost of a desalination project for 10,000 people equals the cost of one tank, and a project for 100,000 people costs about the same as a jet fighter aircraft. It is cheaper to invest in desalination of brackish water, seawater or recycled sewage water than to try to settle disputes over available water sources, most of them already overused."¹²⁵

¹²³Thomas F. Homer-Dixon, "On the Threshold - Environmental Changes as Causes of Acute Conflict," *International Security*, Fall 1991, p. 107.

¹²⁴Reuters, March 23, 1995.

The probability of a successful war by either downstream riparian is also doubtful. Syria may be able to attack the region around the Atatürk Dam by crossing the plain with tanks, and may even be able to hold it for a few months because of Turkey's lack of anti-armor capability.¹²⁶ Nevertheless, after Turkey recovers from any initial setback, it would easily be able to expel any intrusion by Syria or Iraq, even without the support of U.S. and Western European states' which are currently pledged to protect Turkey from foreign invasion. If Syria were able to destroy the Atatürk Dam to prevent the withholding of water, it would cause great damage downstream and draw certain retaliation from the Turks. Iraq, recently defeated by the US-led coalition, has come a long way toward rebuilding its military to pre-1991 levels, but is still not a match for Turkey's superior air power.

5.6 Conclusion

In this chapter I have discussed three solutions to the water crisis in the Tigris-Euphrates River Basin. Rather than individual and unrelated options, sharing, freshwater supply enhancement, and cooperative management, should be viewed as a process. Once some sort of sharing arrangement is in place, and states have established their right to particular quantities of water, they can individually use freshwater supply

¹²⁵Nachmani, p. 314.

¹²⁶Interview with high level US embassy Official in Ankara, Summer 1994.

enhancement to increase their own shares. Finally, they can further maximize their ability to reach their goals by working together. This would have the best long term outcome for the region and could provide the collateral benefits of stability and peace.

In the event that neither Turkey is willing to share some of its water resources, nor Syria and Iraq are willing to accept Turkey's plan or some other cooperative management scheme, a desperate war may be the only alternative. But, more likely, is that Turkey, Iraq and Syria will find some common ground on which to resolve their water problems.

Conclusion

Given the costs, both in terms of physical destruction and economic dislocation, it is unlikely that war will break out over water in the Tigris-Euphrates Basin. Neither Syria nor Iraq is strong enough to invade Turkey for its water resources, especially if Turkey's NATO commitment is considered.

However, given the dire consequences of failing to come to some sort of agreement on the waters of the Tigris-Euphrates Basin, either riparians will be forced to cooperate or will fight over scarce water. Based on the data presented, there are insufficient waters in the Basin to support the riparians' competing development goals.

Turkey faces the choice of asserting its 'power' position vis a vis its downstream neighbors, or 'win points' as an 'all around good guy' by concluding a permanent agreement on the Basin's waters. Because of pressures from Western Europe and the United States for Turkey to support general regional stability, the latter is the more likely alternative.

As states expand their water supplies they will naturally turn toward freshwater creation and conservation as rapidly as their financial ability and available technology allows.

Water transfer schemes are expensive, but may provide great benefits to the regions which would receive those waters. If Turkey finds that it can profitably transfer waters from the Ceyhan and Seyhan rivers it would likely do so. Turkey may also receive

funding toward this end from some international organization or state with an interest in peace and stability in the Middle East. To enable Syria to use a greater portion of the Euphrates waters, Iraq would need to use the Tharthar Canal to transfer water from the Tigris.

The experts who have predicted war as the eventual outcome to the Tigris-Euphrates river dispute may have taken the simplistic and fatalistic view that Turkey, Iraq, and Syria cannot reconcile their differences under any circumstances. Once Turkey, Syria, and Iraq realize the benefits attainable by cooperative management they may be more willing to negotiate as a way of achieving more sustainable long-term development.

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